THURSDAY, AUGUST 7, 1884

ELECTRIC LIGHTING

A Practical Treatise on Electric Lighting. By J. E. H. Gordon. (London: Sampson Low and Co., 1884.)

PRACTICAL treatises on this subject are very numerous, but they do not emanate from the right men. We want a book from a perfectly independent authority, unflavoured with the taint of invention, the result of practical experience. Mr. Gordon is in many respects well qualified for the task, but he is an inventor, and his book is strongly impregnated with prejudice and a green-spectacle view of the subject. He is, however, a staunch believer in the immediate future of successful electric lighting, and is very hopeful that the dark clouds that now envelop it will be dispelled by the enlightenment of steady progress.

After an introductory chapter on the general principles of artificial lighting, he deals with the conversion of electric currents into heat, and shows how carbon, when raised to incandescence, fulfils all the conditions required to give the maximum light with the minimum expenditure of heat. The problem is to concentrate the heat in a solid of the smallest possible size or with the smallest possible cooling surface. Electrical units—amperes, volts, ohms, coulombs—and their relation to each other and to the ordinary heat and work units are explained, though, curiously enough, that most useful and much employed unit the *watt* is not even mentioned. The rules that regulate derived currents lead to an investigation of the method of calculating the power wasted in a network of conductors—a matter of very serious consequence in the commercial aspect of electric lighting, though Mr. Gordon does not touch on any of the recent methods devised to reduce the excessive cost of mains. We then have a disquisition on the experimental measurements of currents, electromotive forces, resistances, and power developed, with a description of various indicators and measurers employed. No reliable instrument has yet been introduced for ordinary practical use, and there are many instruments now undergoing trial which Mr. Gordon has not touched upon—particularly those of Marcel Deprez in use on the Continent, and which were exhibited at Munich and Vienna.

A capital chapter is devoted to glow lamps. "The first public exhibition of incandescent lamps that was made in this country was made by Mr. Swan before the Society of Telegraph Engineers on November 24, 1880. The first exhibition in America was made by Mr. Edison" (p. 62). Mr. Gordon does not give the date! Arc lamps follow, Mr. Crompton's admirable lamp being that selected for description.

Perhaps the most valuable and certainly the most novel chapter in the book is that written by Mr. Crompton on carbons used in arc lamps. The following information is useful (p. 105):—

"The diameters most commonly used have been as follows:

For currents from	7–12 amperes	9 mm. to 11 mm. diameter.
,,	12–18 ,,	11 mm. to 13 mm. ,,
,,	18–25 ,,	13 mm. to 15 mm. ,,
,,	25–40 ,,	15 mm. to 18 mm. ,,
,,	40 upwards	18 mm. to 20 mm. ,, ”

And the following is startling:—

Illuminating Power per Electrical H.P. of 13 *mm. Carbons of different Makers. Currents from* 15 *to* 20 *amperes*

Name of Maker	Candle Power per H.P.
Siemens (cored), pos. Carré (cored), neg.	4270
Siemens (cored)	3514
Barnsley Co.	3500
Johnson and Phillips	2986
Sautter and Lemonnier	2920
Carré (not cored)	2773
Silvertown (Gray's)	2580
Carré (cored)	1972

We then have a chapter on magnets and electro-magnetic induction, which leads to the general principles and theory of electric generators, including a very admirable account of that important subject, self-induction.

"*It is found experimentally, and can be proved mathematically, that if a coil of wire forms part of a circuit, and an alternating E.M.F. sends a current through it, that the current will be much less than it would have been had the same resistance been interposed in the form of a straight wire.*

"*Further, the proportional diminution becomes greater as the current is increased by the reduction of the resistance; and finally, for a given E.M.F., a given rate of alternation, and a coil of given shape, a limit is reached beyond which even reducing the resistance to zero does not increase the current*" (p. 123).

"*This diminution, however, does not, to the best of my belief, waste energy or diminish the efficiency of the machine; it only diminishes its output. Thus self-induction increases the size of a machine required to feed a certain number of lamps, but it does not perceptibly increase the H.P. required to drive the machine with that number of lamps on it.*

"The effect of self-induction increases as the current increases, and therefore *short-circuiting a coil of an alternating machine does not indefinitely increase the current in that coil, and seldom increases it enough to injure the insulation*" (p. 137).[1]

Of course we have a good description of alternate-current machines, and after some adverse criticism of the Ferranti type (which is imperfectly described), and not justified by the performance of the latter, Mr. Gordon describes his own form, which is chiefly distinguished by its size and weight. A few direct-current machines are described—not the best—and their regulation briefly referred to, with the curious conclusion (p. 183):—

"CONCLUSION.

"*The true secret of successful regulation is to have very large dynamos, because then, as we have said before, the maximum number of lamps that can be turned out at one time is a very small percentage of the whole*, and when there are a great number of lamps on one machine, the cost per lamp of regulating, either by hand or by an elaborate mechanical contrivance, is very trifling."

Goulard and Gibbs' secondary generators and the various secondary batteries are briefly despatched. *Apropos* of the latter he says (p. 191):—

"*There is no doubt that the interest and depreciation on a set of secondary batteries large enough to enable an electric light plant to work day and night, and so give*

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[1] The italics are not ours.

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out to the lamps no electricity in the day but a double quantity in the night, is vastly greater than the interest and depreciation on a complete duplicate set of engines, boilers, and dynamos."

Photometry has only one page devoted to it, and Chapter XIX. is so unique that we reproduce it in full (p. 201):—

"CHAPTER XIX

"CENTRAL STATION LIGHTING

"I had intended to write a long chapter with the above heading, but, for various reasons, I am not yet prepared to do so. I have, however, left in the heading, for the convenience of inserting such a chapter in a future edition of this book, should one ever be required."

This reminds one of the celebrated chapter about Snakes in Ireland: "There are no snakes in Ireland."

The book ends with the excellent rules and regulations for the prevention of fire risks prepared by the Society of Telegraph Engineers. Several useful tables are given in the appendix.

The book is disappointing not for what it contains but for what it does not contain. There is in it a strange mixture of the elementary and the advanced. After an algebraical description of the relations that exist between current work and power, we are told by a footnote (p. 19), "The symbol $\sqrt{\ }$ means 'square root of' the quantity under it." There is much hasty editing. At p. 30 we are promised in a footnote a mathematical proof in the appendix which does not appear there. At p. 25 the symbol for a battery is wrong—the poles are reversed. The present value of H at Greenwich is given at p. 40 as ·1794, and at p. 48 as ·181. The illustrations, it may be remarked, are excellent.

It is to be hoped that a second edition will soon be required, so that Mr. Gordon may be able to remedy the defects of the present one. A good practical treatise is very much needed.

W. H. P.

OUR BOOK SHELF

A Text-Book on the Method of Least Squares. By Mansfield Merriman. (New York: John Wiley and Sons, 1884.)

THIS may almost be looked upon as a second edition of the "Elements" by the same author, which we favourably noticed in NATURE (vol. xviii. p. 299) soon after its appearance. The sale of the entire edition of the smaller book may be taken as evidence of its having met a want. The present work, though larger in appearance, covers about the same extent of ground, but, as is pointed out by the author, "the alterations and additions have been so numerous and radical as to render this a new and distinct book rather than a second edition."

In Chapters I. to IV., which present the mathematical developments of the principles, methods, and formulas, Dr. Merriman gives an introduction, and discusses the law of probability of error, the adjustment of observations, and the precision of observations at some length, and illustrates with numerous (for this subject) examples. In Chapters V. to IX. the application of the above to different classes of observations is made. These chapters are respectively headed: Direct Observations on a Single Quantity, Functions of Observed Quantities, Independent Observations on Several Quantities, Conditioned Observations, and the Discussion of Observations. These discussions are likely to be of use to engineers and others specially interested in this branch of mathematics. In an appendix, *inter alia*, there is a short statistical statement on the history and literature of the subject, but the fuller list of literature of the earlier book is not reproduced: there are also given here eight handy tables and some other useful material. It is the only work of the kind with which we are acquainted, and is even better adapted, in our opinion, for the end Dr. Merriman has in view than his earlier book was.

Some Propositions in Geometry. In Five Parts. By John Harris. (London: Wertheimer, Lea, and Co., 1884.)

WHEN we received the parcel containing this work with some others for review, we speculated upon what the Editor could have sent us, and hope rose within our breast that some *magnum opus* awaited our perusal. But as we had heard no whisper of such work being on its way, our expectation cooled, and again casting our eyes on the unopened packet, and remembering former works of similar dimensions, a chill seized us, and we thought to ourselves, "Aut H. aut..." Shade of De Morgan! what are we to do with a work occupying 144 + 8 quarto pages treating of a subject so thoroughly threshed out, we had hoped, in your immortal "Budget"?

The title is an attractive one, and much of the work appears to be sound, but when we come across such problems as the trisection of any angle, the inscription of heptagons and nonagons in circles, *et id genus omne*, one draws in one's breath, and one's hair stands on end! The tentative methods given we dare say would enable one to perform these several operations to a very close degree of approximation, but this is not what ordinary mathematicians want. But we must be careful here, for Mr. Harris puts the question, "What is a *mathematician?*" and in his answer splits the creature up into "sorts." There is, for instance, the very positive and readily incensed mathematician, the highly exalted mathematician, the profound mathematician, and the exclusive orthodox mathematician.

It is under this last "sort" that we fear we must be classed. With him "'Mathematics' is a sort of privileged religion, having its special *articles* and technical dogmas. None but the initiated must enter its temple, and woe be to him who dares to do so without a formal certificate from its priests. One of his most valued dogmas is that $\pi = 3{\cdot}14159\ldots$ This is called an approximation; and which if a man do not faithfully believe he will inevitably go—— Ah, well, never mind where he will go to; but, at all events, no mathematician must hold converse or communication with such a profane person."

It will be seen from this extract that Mr. Harris is a man of some humour, but even such oases do not render the vast Sahara of much of his book pleasanter reading. Indeed we have found it very hard work, and so we contented ourselves (for review purposes) with the careful reading of one of the "trisection" proofs; but we gave up in despair, as this proof involved the mastery of a previous proof, and we feared it would be a case of little fleas and lesser fleas, "and so *ad infinitum*." What did we do next? Why we applied a trigonometrical test, and found that the method in the text would not give the result at all, except in a special case. Life is really too short for such verification, and we must leave the task to others. The figures, as usual with Mr. Harris, are carefully drawn and very elaborate diagrams.

We regret more and more that so much labour should be bestowed upon such studies, which, we fear, an unbelieving world will never take up. What, then, is the value of π? It is here said to be (Mr. Harris would say, proved to be) equal to $\sqrt{8} \times \frac{10}{9} = 3{\cdot}142696\ldots$

We lay down the book more in sorrow and pity than in anger and scorn.

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